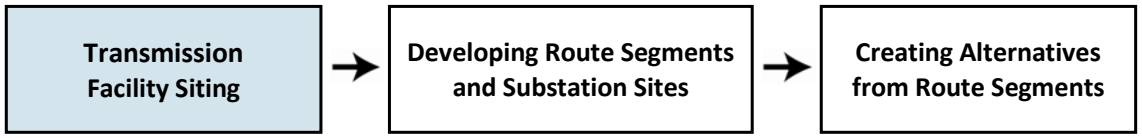
Chapter 2 Facility Siting, Route Segments, and Action Alternatives

This chapter describes how BPA system planners, engineers, and other specialists propose locations for new transmission facilities, such as the proposed I-5 Project. It describes the general factors that BPA considers in siting potential new facilities. It then discusses how potential transmission line route segments and substation sites for the project were developed and refined over time. It also explains how these route segments were combined into the action alternatives for this project.

2.1 Facility Siting



BPA is proposing to build a 500-kV lattice-steel tower transmission line that would run about 70 miles from a new 500-kV substation near Castle Rock, Washington to a new 500-kV substation near Troutdale, Oregon. A transmission project of this size requires many components (see Table 2-1). These components are discussed in detail in Chapter 3, Project Components and Construction, Operation, and Maintenance Activities.

Table 2-1 Project Components

Components	Description
Transmission towers	Single-, double- or triple-circuit towers depending on location; 60 to 280 feet tall depending on voltage and location.
Right-of-way easements	Generally 150 feet wide depending on location.
Wires (lines; conductors)	Conductors to transmit power, ground wire for lightning protection, fiber optic cable for communications.
Access roads	New or improved roads depending on location, and existing roads for access to each tower for construction and maintenance.
Vegetation clearing	Vegetation cleared from the right-of-way, access roads, and substation sites and danger trees outside the right-of-way.
Staging areas	Material and vehicle storage for construction.
Pulling and tensioning sites	Areas to string wire and tighten wires after they are placed on the towers.
Removal of existing structures/towers and lines and rebuilding some towers	Removal of existing transmission structures/towers and lines in some locations to provide room for the new line. Some towers would be removed and rebuilt as double- or triple-circuit towers with the new line and the existing line strung on the new towers.
Substations	A new 500-kV substation at each end of the transmission line. About 25-50 acres would be required for each substation and stormwater retention pond design depending on location.

BPA considers many factors when siting proposed new transmission lines. Once the need for a new line in a particular area or region is identified, BPA's transmission system planning engineers begin developing potential routes for a proposed new line. They determine the size or voltage needed and the beginning and end points for the transmission line based on the needs of the electrical transmission system. Design engineers then determine the type of towers and the amount of right-of-way necessary for safety clearances for the size of line. In general, a 500-kV transmission line has a 150-foot-wide right-of-way. Each tower location must also be accessible for construction and for maintenance, so road access is generally required.

With the technical requirements outlined, including the desired beginning and end points of the line, siting engineers use available information to consider how a new line and substations might be placed effectively to provide for cost-effective construction and reliable operation. The siting engineers also consider potential impacts to people; plants and animals; land use; farms and other businesses; and important local, cultural, and regional features. They look for ways to site new transmission facilities to avoid or minimize these potential impacts to the extent practicable. Some factors considered in this initial transmission facility siting effort include the following:

- Electrical feasibility: New electrical facilities must be compatible with the operation of the existing transmission system. In some areas where there are existing lines, new transmission lines may not be allowed immediately adjacent to these existing lines (see bullet below on line separation). The line length between substations may be limited due to effects the length can have on electrical performance and power distribution across the system. Substations are strategically placed to provide efficient, flexible operation of the system and enhance the flow of power. For this project, the proposed substation sites are in locations that would provide the maximum system performance together with a new transmission line.
- Existing transmission corridors and roads: Engineers determine if BPA or other utilities have any existing corridors with vacant rights-of-way or whether a new line could parallel another existing or proposed line, facility, or road. Building in an established corridor tends to have different impacts to visual resources, land use, wildlife habitats, and people than creating a new corridor. Existing access roads may be able to be used, though they often need to be improved. Building next to an existing line may be less expensive where there is extra right-of-way to accommodate a new line, with little or no need to purchase new easements, but as discussed below, there may be line separation issues. Some maintenance, such as vegetation clearing, could be less expensive when two lines are next to each other, rather than being in different areas.
- Line separation: While use of existing transmission corridors has its advantages, there are situations in which BPA cannot build next to existing lines for reliability reasons. If utilities want to build a transmission line next to an existing line, they are required by WECC and NERC reliability criteria (see Section 1.1.3, Planning for Transmission Additions in the I-5 Corridor) to consider the consequences of an outage that could affect both lines. Utilities consider the following events, among others, that could cause a simultaneous outage of lines:
    - An aircraft flying into both lines
    - Fire in the right-of-way producing smoke, which can cause a flashover between lines

- Sequential lightning strikes
- A tower or conductor failing and falling into an adjacent line
- A landslide taking out towers on more than one line in a corridor
- A localized high wind or heavy ice event

The consequences of an outage are greater with the simultaneous loss of two critical lines in an area. These outages could be beyond what the system can withstand and greatly increase the chances for a blackout of the system. To reduce the chances of a blackout from outages of multiple critical lines in an area, BPA limits capacity to reduce the degree to which a part of the system is relied upon (see Section 1.1.2.2, Reliability and Non-Wires Measures).

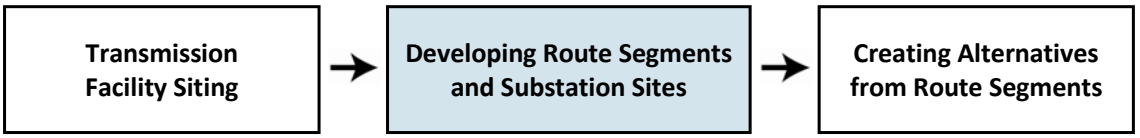
If BPA determines that the likelihood and consequence of an outage would not meet WECC and NERC reliability criteria, special design considerations are required. A new line would be required to be separated by at least one span length (about 1,200 feet) from the adjacent line.

For this project, BPA studied placing the proposed line next to an existing high-voltage 230-kV transmission line. Though WECC reliability criteria require BPA to plan for the simultaneous loss of a new 500-kV line and the existing line, BPA determined that the impacts of such an outage could be mitigated by using RAS (see Section 1.1.2.2, Reliability and Non-Wires Measures), and that placing a new line next to the existing 230-kV transmission line could be considered for the project.

- Houses, other structures, and sensitive cultural resources: Homes, schools, businesses, historic structures and sensitive cultural resource areas are generally avoided during line routing. Because structures (houses, buildings, sheds) are not allowed within the right-of-way for safety reasons, BPA looks to avoid structures while selecting a right-of-way so they need not be removed.
- Existing land uses: In addition to existing houses and structures, land use is an important consideration. Siting engineers try to find compatible land uses, while trying to minimize impacts to residential land, parks and preserves, and any special districts or areas of local or regional interest. Gravel pits are avoided, because pit operators often extract material up to the tower legs, leaving them exposed, unstable, and without maintenance access to the tower. BPA also prefers to avoid airstrips if possible; tries to follow fence lines; and spans agricultural fields, orchards, or vineyards where practical.
- Terrain: BPA looks for gentle terrain if available. Transmission towers and access roads placed on steep slopes are harder to construct and maintain, and may be more susceptible to failures due to erosion or landslides.
- Visual impacts: The size of transmission towers and the potential need to clear trees and develop new roads can increase the visibility of a new line. BPA considers avoiding locations such as homes and roads, river crossings, and parks and other recreation areas, from which people would likely view a new line and substations.
- Sensitive habitats: Engineers consider potential impacts to plants and animals and try to avoid wetlands, nesting sites, threatened and endangered species' habitats, and other sensitive areas wherever practical.
- Costs: BPA tries to develop the most cost-effective alternatives. Shorter transmission line routes usually decrease overall project costs. Straight transmission lines are less costly than lines that turn because when lines turn, stronger, heavier, and more

expensive towers are needed. Level routes are less costly than routes across steep terrain because less grading is required. Included in project costs are the purchase of land for substations and possibly substation access roads, and transmission line and access road easements. Easements across agricultural or forest lands are usually less expensive than easements across residential land.

2.2 Developing Route Segments and Substation Sites



After the general location of a proposed new transmission line is identified, BPA's siting engineers begin the process of more specifically identifying potential sites for the necessary substations at either end of the proposed transmission line, and developing potential routes for the transmission line between these substation sites. The siting engineers use a variety of information sources to further refine the route segments and potential substation sites. They consider the identified transmission system needs and numerous siting factors discussed in Section 2.1, Facility Siting. They take into account the location of existing generating facilities, transmission lines, and substations in the area (see inset box and Figure 2-1). They consult maps and conduct field checks of potential routes and substation sites.

For this project, BPA first identified potential route segments and substation locations in the early 2000s, when the potential need for the I-5 project was initially identified. However, because rising gas prices caused proposed generation plants to be put on hold (delaying expected congestion) and BPA took actions to avoid building new lines in this area (see Sections 1.1.2.2, Reliability and Non-Wires Measures, and 1.1.3, Planning for Transmission System Additions in the I-5 Corridor), BPA was able to put the proposal to build the I-5 project on hold at that time, and work ceased on developing route segments and potential substation sites.

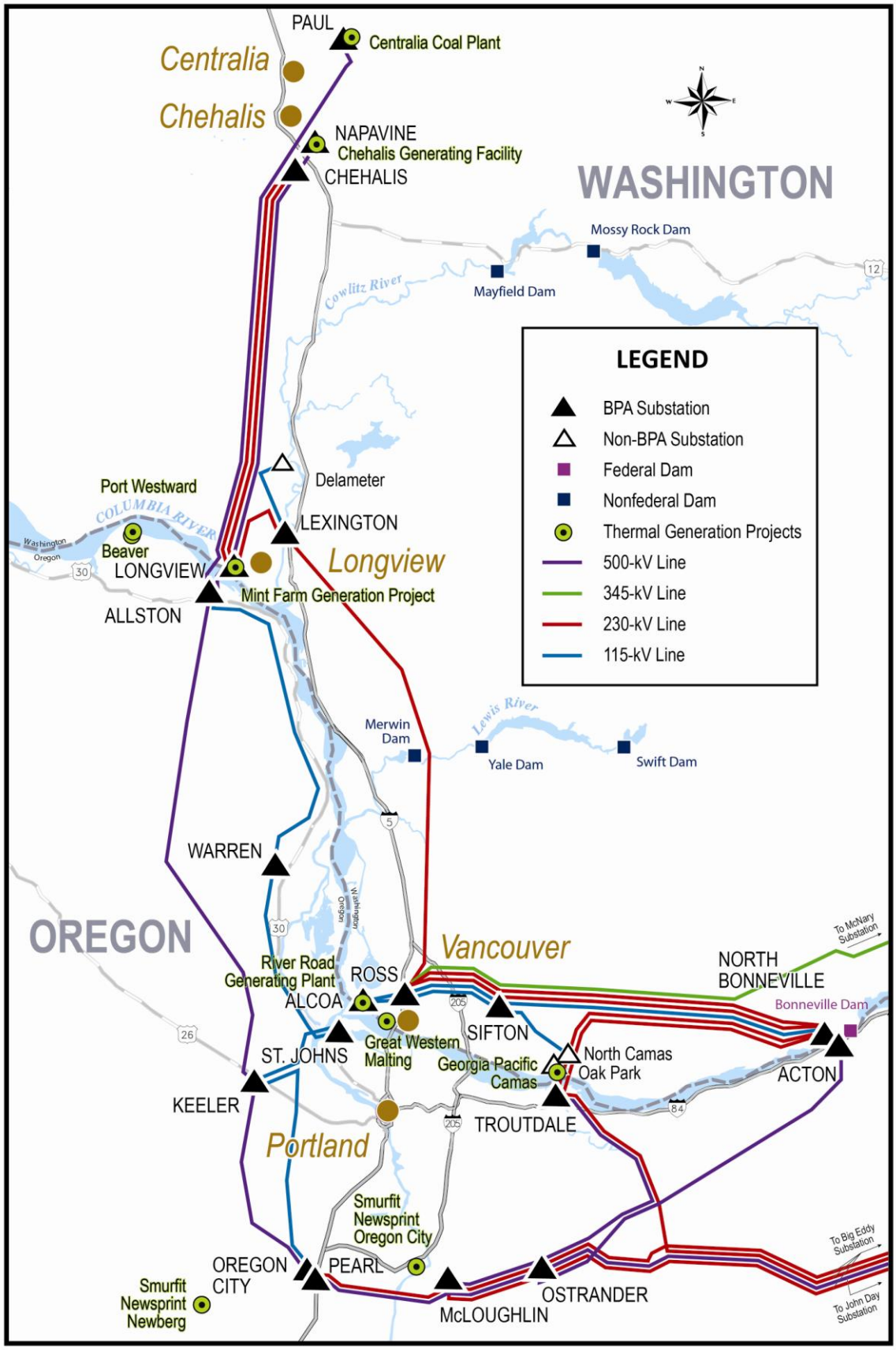
When the need for the project began to re-emerge in the late 2000s, BPA's siting engineers reinitiated work to further develop route segments and potential substation sites. The siting engineers identified an area near existing transmission lines in the vicinity of Castle Rock, Washington for one of the new substations, and a site near BPA's Troutdale Substation in Troutdale, Oregon for the other new substation (see Map 2-1). BPA then began to look at potential routes for a new transmission line between these two endpoints. In theory, there are an almost unlimited number of potential routes between the Castle Rock area and the Troutdale area. Using the information sources discussed above, however, BPA's siting engineers identified a variety of potentially feasible transmission line route segments between the two endpoints. These segments can be combined in many ways that provide a reasonable range of alternate routes to get from one endpoint to the other (see Section 2.3, Creating Alternatives from Route Segments).

BPA and Non-BPA Transmission Lines and Substations in the Project Area

There are many existing transmission lines and substations in the project area (see Map 1-2). Figure 2-1 is a schematic of general line and substation locations. Not all lines listed below are shown on the figure; conversely, not all substations or lines shown on the figure are listed below. In general, lines are named by where they begin and end at substations. For example, the Lexington-Delameter line begins at Lexington Substation and ends at Delameter Substation. Lines and substations are owned by BPA unless noted by an *.

- Lexington-Delameter No. 1 115-kV single-circuit line (BPA leases to Cowlitz PUD)
- Longview-Chehalis No. 1 230-kV single-circuit line
- Lexington-Longview No. 2 230-kV single-circuit line
- Napavine-Allston No. 1 500-kV single-circuit line
- Longview-Chehalis No. 3 230-kV single-circuit line
- Paul-Allston No. 2 500-kV single-circuit line
- Ross-Lexington No. 1 230-kV single-circuit line
- Sifton-Ross No. 1/Bonneville-PH1-Alcoa No. 2 115-kV double-circuit line
- McNary-Ross No. 1 345-kV single-circuit line
- North Camas-Sifton No. 1/Bonneville PH1-Alcoa No. 2 115-kV double-circuit line
- North Bonneville-Ross No. 1/North Bonneville-Ross No. 2 230-kV double-circuit line
- North Bonneville-Ross No. 1 230-kV single-circuit line
- North Bonneville-Ross No. 2 230-kV single-circuit line
- North Bonneville-Troutdale No. 1 230-kV single-circuit line
- North Bonneville-Troutdale No. 2 230-kV single-circuit line
- North Camas-Oak Park 115-kV single-circuit line
- Cowlitz-County PUD Lexington-Corduroy 115-kV single-circuit line
- Georgia Pacific James River East 115-kV single-circuit line*
- Georgia Pacific James River West 115-kV single-circuit line*
- PacifiCorp 230-kV double-circuit line*
- PacifiCorp 115-kV single-circuit line*
- Troutdale Substation
- Paul Substation
- Lexington Substation
- Allston Substation
- Ross Substation

Figure 2-1 Schematic Location of Existing Transmission Lines and Substations



When BPA formally proposed to build the I-5 project in 2009, BPA used the refined route segments and substation locations it had developed to identify landowners and other interested parties, to aid in determining land use and other initial resource information, and to allow the public, Tribes, agencies, and others to comment on the initial proposal (see Section 1.6, Public Involvement and Major Issues). As BPA moves through the planning, preliminary design, and environmental process for this project, these route segments and substation locations are being further refined and adjusted as new information is obtained. The following sections describe changes to the location and number of route segments and substation sites since the project was first proposed. (See Section 4.7, Alternatives Considered but Eliminated from Detailed Study, for additional suggested route locations and alternatives considered but eliminated from further consideration.)

2.2.1 Transmission Line Route Segments

Between the areas identified near Castle Rock, Washington and in Troutdale, Oregon for new substations, BPA's engineers identified 52 preliminary transmission line route segments that could be combined in various ways to form different potential routes for the transmission line. These route segments varied in length and were composed of existing and new rights-of-way or paralleled existing rights-of-way. The preliminary public notification area for each route segment was from 500 feet to greater than 1 mile wide, depending on the terrain and land use. The actual area needed for the transmission line right-of-way is generally 150 feet wide, and about 25 to 50 acres for each new substation.

After hosting public meetings, reviewing comments received during and after the scoping period, and months of study and extensive field work, BPA refined the route segments that would be considered. Changes made between October 2009 and November 2010 included refining segments, removing some segments and portions of others from consideration, and adding segments farther to the north and east (identified with letters) (see Map 2-1). New substation sites near Castle Rock were also developed (see Section 2.2.2, Substation Sites), and segments were developed to extend the transmission line to those sites. (See Section 4.7, Alternatives Considered but Eliminated from Detailed Study, for a description of the segments removed.) After a series of refinements, BPA identified 60 route segments to be analyzed in the EIS (see Map 2-2).

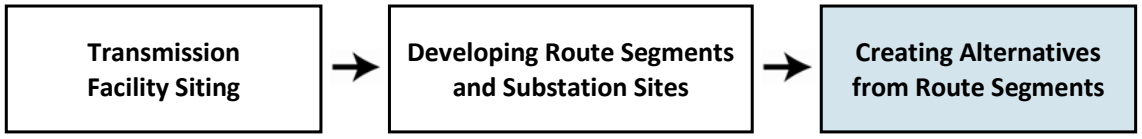
2.2.2 Substation Sites

As discussed earlier in this section, the northern end of the transmission line would connect to a proposed new substation near Castle Rock, Washington. BPA initially considered one general area for a new substation at this location. After public comment, extensive field work, and preliminary substation design work, BPA expanded its substation site alternatives and is now considering three sites for a new substation near Castle Rock: Monahan Creek, Baxter Road, and Casey Road (see Map 2-2). The Monahan Creek site would use an open area at the intersection of existing BPA lines. The Baxter Road and Casey Road sites are alternate sites considered because of their relative remoteness and proximity to BPA lines.

The southern end of the transmission line would connect to a proposed new substation near BPA's existing Troutdale Substation in Troutdale, Oregon. Since this site is located along Sundial Road, it is referred to as the Sundial substation site.

Chapter 4, Proposed Action and Alternatives, describes the work specific to each substation site that would be required to construct a substation at each location.

2.3 Creating Alternatives from Route Segments



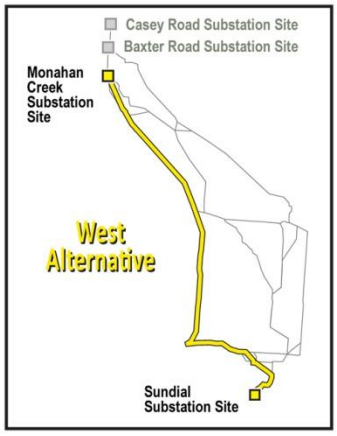
After the refined route segments and potential substation sites were developed, BPA worked to create a range of action alternatives using these project components. In creating these alternatives, BPA continued to consider the many environmental, technical, social and economic siting factors used in developing the route segments (see Section 2.1, Facility Siting). BPA also considered comments received from the public during the various public outreach activities conducted for the project (see Section 1.6, Public Involvement and Major Issues).

BPA has identified four action alternatives for detailed evaluation in this EIS: the West Alternative, the Central Alternative, the East Alternative, and the Crossover Alternative (see Maps 2-3 through 2-6). For each action alternative, three options have also been identified that involve use of slightly different route segments (i.e., where some line segments are replaced with different ones), different substation sites, or a combination of both. Through these action alternatives and options, BPA was able to ensure that each of the 60 identified route segments, and each of the three Castle Rock area substation sites, was used in at least one of the alternatives considered in this EIS. In addition, some of the route segments and substation sites are included in more than one action alternative.

In creating action alternatives, BPA sought to develop a range of alternatives with different considerations. Accordingly, the West Alternative would be located in more urban and developed areas and would use mostly existing right-of-way. The Central and East alternatives would be located in more rural and undeveloped areas on mostly new right-of-way and would be located in generally distinct geographic areas north to south and west to east. The Crossover Alternative would use a combination of existing and new right-of-way.

Each action alternative includes a new substation near Castle Rock, a 500-kV transmission line between 67 and 80 miles long, and the new Sundial Substation near Troutdale, Oregon. All action alternatives cross the Columbia River in the same location. All include fiber optic cable on the towers to provide a communication link between the substations, and equipment changes inside control houses at various BPA substations. The following provides an overview of route segments and substation sites used in each of the four action alternatives and their options. Chapter 4, Proposed Action and Alternatives, describes the alternatives in more detail.

2.3.1 West Alternative and Options



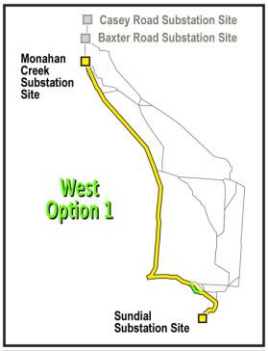
2.3.1.1 West Alternative

The West Alternative begins at the Monahan Creek substation site, then extends south on route segments 2, 4, 9, 25, 36B, 41, 45, 50, and 52 and connects to the Sundial substation site (see Map 2-3 and Table 2-2). The West Alternative is about 67.5 miles long.

Table 2-2 West Alternative and Options

Alternative and Options	Substations and Segments Used to Form Alternative (North to South)	Segments or Substation Site Removed to Form Option	Segments Added to Form Option
West Alternative	Monahan Creek, 2, 4, 9, 25, 36B, 41, 45, 50, 52, Sundial		
West Option 1		36B, 41, 45	36, 40, 46
West Option 2		36B, 41, 45, 50	36, 36A, 37, 38, 43, 48, 51
West Option 3		36B, 41, 45, 50	36, 36A, 37, 38, 39, T, 49, 51

2.3.1.2 West Option 1

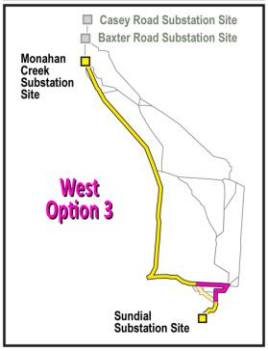


West Option 1 includes route segments 36, 40, and 46 instead of segments 36B, 41, and 45 (see Map 2-3 and Table 2-2). West Option 1 is about 3.4 miles long and replaces segments 3.3 miles long, so it is 0.1 mile longer.

2.3.1.3 West Option 2

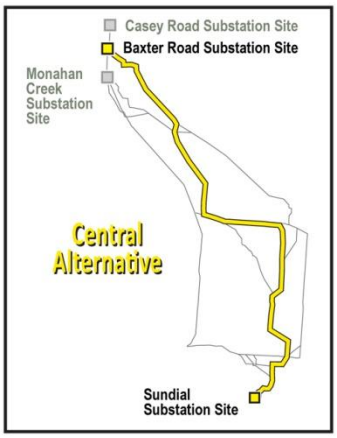
West Option 2 includes route segments 36, 36A, 37, 38, 43, 48, and 51 instead of segments 36B, 41, 45, and 50 (see Map 2-3 and Table 2-2). West Option 2 is about 9 miles long and replaces segments that are 7.4 miles long, so it is about 1.6 miles longer.

2.3.1.4 West Option 3



West Option 3 includes route segments 36, 36A, 37, 38, 39, T, 49, and 51 instead of segments 36B, 41, 45, and 50 (see Map 2-3 and Table 2-2). West Option 3 is about 13 miles long and replaces segments 7.4 miles long, so it is about 5.6 miles longer.

2.3.2 Central Alternative and Options



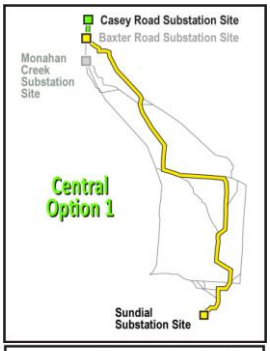
2.3.2.1 Central Alternative

The Central Alternative begins at the Baxter Road substation site, then extends south on route segments B, F, G, H, 10, 12, 15, 23, L, 18, 28, V, P, 35, T, 49, 51, and 52 and connects to the Sundial substation site (see Map 2-4 and Table 2-3). The Central Alternative is about 77.3 miles long.

Table 2-3 Central Alternative and Options

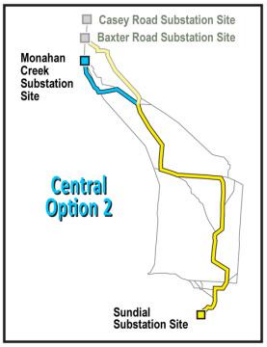
Alternative and Options	Substations and Segments Used to Form Alternative (North to South)	Segments or Substation Site Removed to Form Option	Segments Added to Form Option
Central Alternative	Baxter Road, B, F, G, H, 10, 12, 15, 23, L, 18, 28, V, P, 35, T, 49, 51, 52, Sundial		
Central Option 1		Baxter Road	Casey Road, A
Central Option 2		Baxter Road, B, F, G	Monahan Creek, 1, 4, 5, 8, 11
Central Option 3		L, 18, 28, V	M, 26, 30

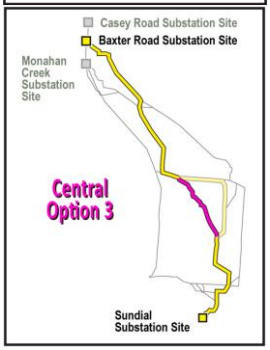
2.3.2.2 Central Option 1



The Central Option 1 route begins at the Casey Road substation site instead of the Baxter Road substation site and includes route Segment A (see Map 2-4 and Table 2-3). Central Option 1 is about 2.5 miles long and does not replace any other segments.

2.3.2.3 Central Option 2





Central Option 2 begins at the Monahan Creek substation site instead of the Baxter Road substation site and includes route segments 1, 4, 5, 8, and 11 instead of segments B, F, and G (see Map 2-4 and Table 2-3). Central Option 2 is about 15.7 miles long and replaces segments that are 18 miles long, so it is about 2.3 miles shorter.

2.3.2.4 Central Option 3

Central Option 3 includes route segments M, 26, and 30 instead of segments L, 18, 28, and V (see Map 2-4 and Table 2-3). Central Option 3 is about 15 miles long and replaces segments that are about 21 miles long, so it is about 6 miles shorter.

2.3.3 East Alternative and Options

2.3.3.1 East Alternative

The East Alternative begins at the Baxter Road substation site, then extends south on route segments B, F, I, K, W, O, Q, S, 49, 51, and 52 and connects to the Sundial substation site (see Map 2-5 and Table 2-4). The East Alternative is about 75.5 miles long.

Table 2-4 East Alternative and Options

Alternative and Options	Substations and Segments Used to Form Alternative (North to South)	Segments or Substation Site Removed to Form Option	Segments Added to Form Option
East Alternative	Baxter Road, B, F, I, K, W, O, Q, S, 49, 51, 52, Sundial		
East Option 1		Baxter Road, B, F, I	Monahan Creek, 3, 7, 11, J
East Option 2		O, Q, S	U, V, P, 35, T
East Option 3		Q	R

2.3.3.2 East Option 1

The East Option 1 route begins at the Monahan Creek substation site instead of the Baxter Road substation site and includes route segments 3, 7, 11, and J instead of segments B, F, and I (see Map 2-5 and Table 2-4). East Option 1 is about 17.6 miles long and replaces segments that are 19.4 miles long, so it is about 1.8 miles shorter.

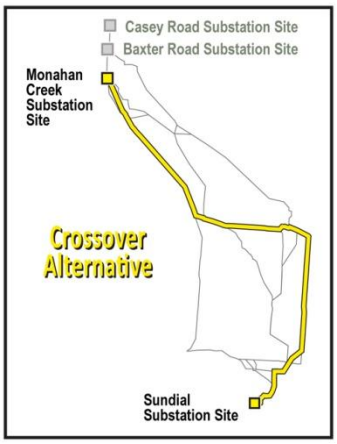
2.3.3.3 East Option 2

East Option 2 includes route segments U, V, P, 35, and T instead of segments O, Q, and S (see Map 2-5 and Table 2-4). East Option 2 is about 23.5 miles long and replaces segments that are 22.5 miles long, so it is about 1 mile longer.

2.3.3.4 East Option 3

East Option 3 includes route segment R instead of segment Q (see Map 2-5 and Table 2-4). East Option 3 is about 3.7 miles long and replaces a segment that is 2.6 miles long, so it is about 1.1 miles longer.

2.3.4 Crossover Alternative and Options



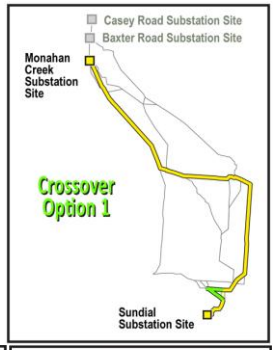
2.3.4.1 Crossover Alternative

The Crossover Alternative begins at the Monahan Creek substation site, then extends south on route segments 2, 4, 9, 14, 15, 23, L, 18, N, W, O, Q, S, 49, 51, and 52 and connects to the Sundial substation site (see Map 2-6 and Table 2-5). The Crossover Alternative is about 74 miles long.

Table 2-5 Crossover Alternative and Options

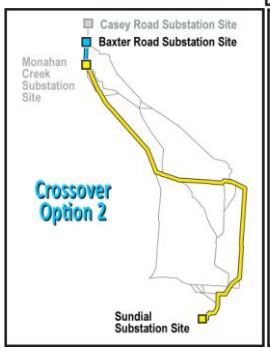
Alternative and Options	Substations and Segments Used to Form Alternative (North to South)	Segments or Substation Site Removed to Form Option	Segments Added to Form Option
Crossover Alternative	Monahan Creek, 2, 4, 9, 14, 15, 23, L, 18, N, W, O, Q, S, 49, 51, 52, Sundial		
Crossover Option 1		51	47, 48, 50
Crossover Option 2		Monahan Creek	Baxter Road, C, E
Crossover Option 3		Monahan Creek	Baxter Road, D, E

2.3.4.2 Crossover Option 1



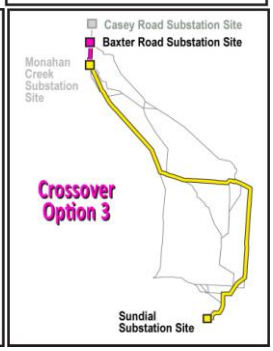
Crossover Option 1 includes route segments 47, 48, and 50 instead of segment 51 (see Map 2-6 and Table 2-5). Crossover Option 1 is about 7.3 miles long and replaces a segment that is 2.1 miles long, so it is about 5.2 miles longer.

2.3.4.3 Crossover Option 2



Crossover Option 2 begins at the Baxter Road substation site instead of the Monahan Creek substation site, and includes route segments C and E (see Map 2-6 and Table 2-5). Crossover Option 2 is about 4.3 miles long and does not replace any other segments.

2.3.4.4 Crossover Option 3



Crossover Option 3 begins at the Baxter Road substation site instead of the Monahan Creek substation site, and includes route segments D and E (see Map 2-6 and Table 2-5). Crossover Option 3 is about 4.2 miles long and does not replace any other segments.